Astragalus asotinensis (Fabaceae), a Newly Discovered Species from Washington and Idaho, United States

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ABSTRACT. *Astragalus asotinensis* Björk & Fishbein (Fabaceae) is newly described from a single population on limestone of the Limekiln Formation at the mouth of Hells Canyon in Washington and Idaho in the United States. This population of several thousand plants has yet to be found on any of the non-calcareous substrates in the vicinity. Its affinities appear closest to *Astragalus* sect. *Podosclerocarpi* A. Gray, which hitherto encompassed three species of the Columbia Basin of British Columbia, Oregon, and Washington, in northwestern North America. *Astragalus asotinensis* represents a disjunct element of section *Podosclerocarpi*, the nearest population of which, in the form of *A. sclerocarpus* A. Gray, occurs 150 km northwest. With species of section *Podosclerocarpi*, *A. asotinensis* shares a strongly cauline habit, creamy white petals, non-gibbous calyx base, and stipitate, curved fruits. It is unique within section *Podosclerocarpi* in having sparse pubescence, a much longer ratio of peduncle-to-raceme length (4:1), and an intermediate leaflet length-width ratio (5:1).

Key words: *Astragalus*, edaphic endemic, Hells Canyon, Idaho, *Podosclerocarpi*, Washington.

Astragalus sect. *Podosclerocarpi* A. Gray (Fabaceae) contains three North American species known from the Columbia River Basin of the Okanagan Valley in British Columbia south to north-central Oregon (Barneby, 1964). *Astragalus sclerocarpus* A. Gray is the most widespread of the trio, with a distribution that encompasses most of the range of the section, and is the only one that occurs outside Washington. It grows in sandy soil and dunes in arid and semiarid regions. *Astragalus speirocarpus* A. Gray is a regional endemic of sagebrush/bunchgrass steppe on hills near the Columbia and Yakima rivers, in Washington. *Astragalus sinuatus* Piper is a narrow endemic known only from steppe near the Columbia River in Chelan County, Washington.

In our exploration of Lime Hill, a large outcrop of limestone surrounded by flood basalts and other non-calcareous substrates (Reidel et al., 1992), we encountered a fourth, undescribed member of *Astragalus* sect. *Podosclerocarpi* that appears to be restricted to limestone. It is morphologically distinct and disjunct by 150 km from the nearest population of any other species of the section (*A. sclerocarpus* in Adams County, Washington).

Astragalus asotinensis Björk & Fishbein, sp. nov. TYPE: U.S.A. Washington: Asotin Co., Grande Ronde River, Lime Hill, just S of confluence with Snake River, ca. 0.75 mi. (air) SE of Rogersburg, 29 May 1999, *M. Fishbein 3922*, *S. McMahon*, *G. Allen & J. Antos* (holotype, WS; isotype, ARIZ, DAV, MO, NY, US). Figure 1.

Haec species *Astragalo sinuato* similis sed foliis sparsim strigosis, supra fere glabris (non dense cinereis pubescentibus), foliolis 15–23 (vs. 11–15) et 4–6 plo longioribus quam latioribus (vs. 2–3 plo longioribus), rachidibus foliorum 54–77 mm longis (vs. 25–40 mm), et fructibus 70°–110° curvis (vs. 45°–65°) differt.

Bushy perennial herb from thick, woody taproot, with very numerous, decumbent to ascending stems; herbage appearing green throughout; stems reaching 40–50 cm in length with strigose pubescence of relatively short hairs, 0.15–0.60 mm. Leaves pinnately compound, pubescence sparse, strigose, adaxial surface of leaflets nearly glabrous and bright green; stipules free, broadly triangular, persistent, 2.5–3.5 mm long; petiole (2–)6–7(–11) mm long; rachis 5.4–7.7 cm long, composed of 15 to 23 leaflets 3.5–7.5 times longer than broad. Inflorescences axillary, racemose; peduncle 6–10 cm long, sparsely strigose, ascending; raceme 18–45 cm long; bracts minute, narrowly triangular, persistent. Flowers 7 to 20; calyx tube 6–7.3 mm long, segments 1.5 mm long, acuminate; petals 5, creamy-white, often lightly tinged with rose or lavender especially on the keel tip; keel surpassed by the wings by ca. 3 mm, wings surpassed

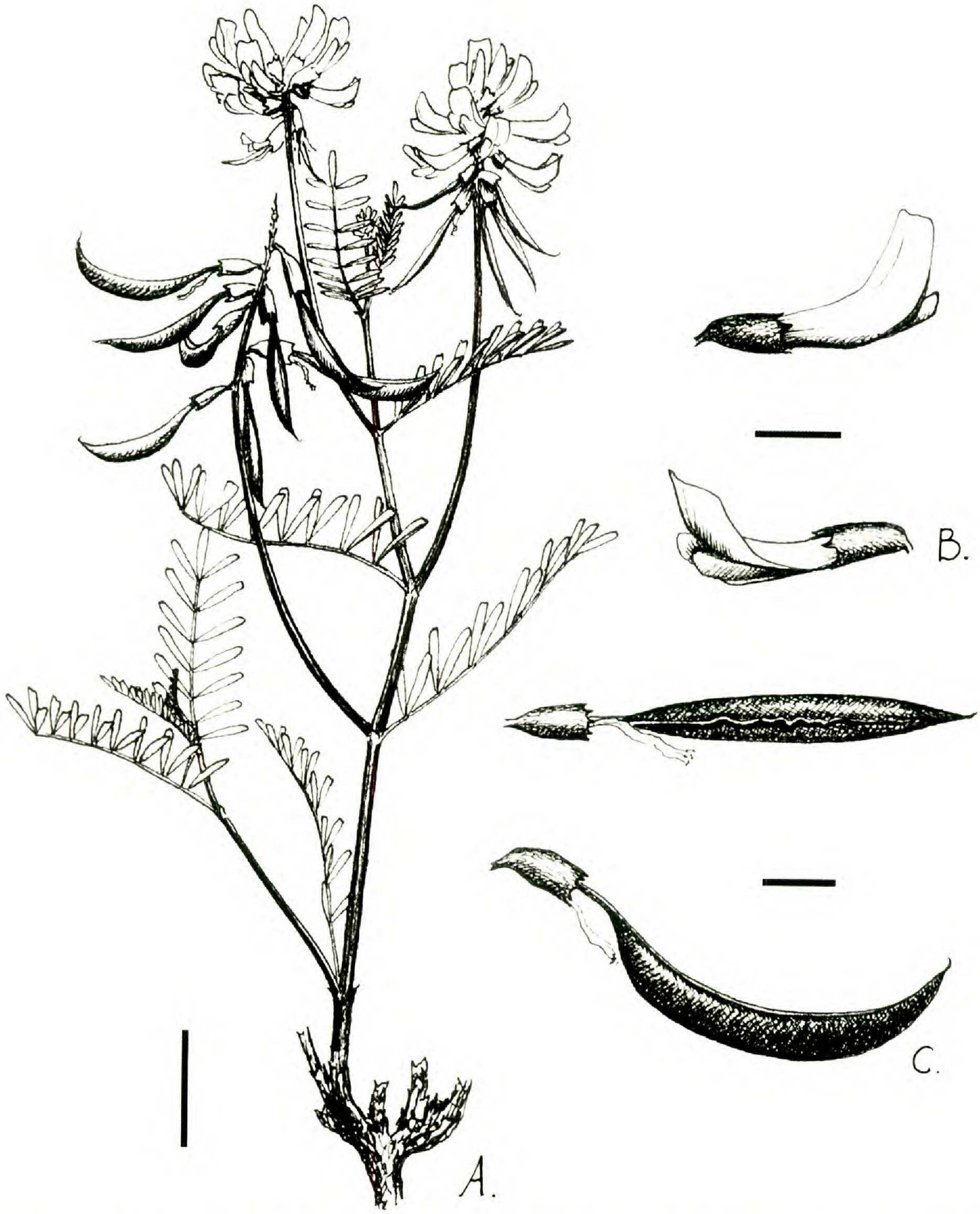

Figure 1. *Astragalus asotinensis* Björk & Fishbein. —A. Habit, with only one of multiple stems depicted. —B. Flowers in oblique lateral views. —C. Abaxial (above) and lateral (below) view of legume, showing slightly sinuous suture. Scale bars: A = 10 cm; B, C = 10 mm. Drawing by C. Björk, from *Björk 1405* (WS).

by the banner by ca. 3 mm; stamens 10; carpel 1 with superior, short-stipitate ovary, white-strigose; ovules 15 to 19. Fruit a dehiscent, stipitate legume 28–37 mm long, sparsely white strigose; at maturity spreading, curved through 70°–110°, straw-colored to reddish brown, very rigid to nearly woody, the abaxial suture straight or moderately sinuate; seeds 4 to 10, grayish brown, distorted-prismatic.

Phenology. *Astragalus asotinensis* flowers between late March and early May, and its fruits mature between early May and early June.

Etymology. *Astragalus asotinensis* receives its name from the county and region of Washington, where it was first discovered. Asotin is reportedly derived from the Nez Perce term for "Place of Eels" (Hitchman, 1985).

Species concept. We recognize the newly discovered population as a new species on the basis of a unique combination of character states, relative to others in *Astragalus* sect. *Podosclerocarpi*. Additional support for the establishment of specific status for this population comes from the vanishingly small proba-

bility of gene flow between *A. asotinensis* and other populations of the section *Podosclerocarpi*, which are disjunct by 150 km or more. Thus, recognition of *A. asotinensis* fulfills criteria of one version of the phylogenetic species concept (Nixon & Wheeler, 1990) and the biological species concept (Mayr, 1963).

Ecology and distribution. *Astragalus asotinensis* occurs as a single population of several thousand individuals limited to limestone-derived soil on the Limekiln Formation of Asotin County, Washington, and Nez Perce County, Idaho, in the northwestern United States. The exposed portions of this formation and the population of *A. asotinensis* are limited to a total area of ca. 4 km^2. We have not been able to locate any individuals of *A. asotinensis* on the flood basalts or other substrates that surround the Limekiln Formation, and thus the species appears to be an edaphic endemic. The population is situated at the northern extreme of Hells Canyon, where the Limekiln Formation constitutes the northernmost station of the Martin Bridge Formation (Reidel et al., 1992). These limestones are derived from coral reefs around islands that accreted onto the continent 300 to 130 million years ago (mya) (Vallier & Brooks, 1994). Our searches for *A. asotinensis* on other limestone outcrops in the region have been unsuccessful. The Limekiln Formation is split into roughly equal halves by the Snake River, as is the known population of *A. asotinensis*.

Astragalus asotinensis appears to favor 30°–50° slopes and is distributed evenly on all aspects. Individuals occur on moderately deep to very shallow loamy soils derived from limestone, or on loose slate slopes. It is common from 400 to 900 m, where it grows in canyon grassland. Here it is associated with the bunchgrasses *Pseudoroegneria spicata* (Pursh) Á. Löve, *Elymus wawawaiensis* J. R. Carlson & Barkworth, *Koeleria macrantha* (Ledebour) Schultes, *Festuca idahoensis* Elmer, and *Poa cusickii* Vasey, along with small shrubs such as *Gutierrezia sarothrae* (Pursh) Britton & Rusby, *Phlox colubrina* Wherry & Constance, and *Glossopetalon spinescens* A. Gray, and a large diversity of forbs. Below about 650 m elevation in the Idaho portion of the population, most potential habitat for *A. asotinensis* is dominated by non-native plants such as *Bromus tectorum* L., *Bromus rigidus* Roth, *Onopordum acanthium* L., and *Sisymbrium altissimum* L., possibly due to a history of grazing. *Astragalus asotinensis* may tolerate some anthropogenic disturbance, as evidenced by the numerous plants recolonizing abandoned jeep tracks. However, few individuals grow in the presence of heavy weed infestations.

Astragalus asotinensis is part of a noteworthy local and regional concentration of biodiversity. The Washington portion of the population and less-disturbed portions in Idaho are habitat for a very rich flora and fauna. A number of species are endemic to the shared border region of Washington, Idaho, and Oregon, including 17 of the plants that occur sympatrically with *A. asotinensis* at Lime Hill. Additionally, a land snail, *Oreohelix idahoensis washingtonensis*, is narrowly endemic to the Limekiln Formation (Pilsbry, 1948) and co-occurs with *A. asotinensis*.

Astragalus asotinensis was first collected in 1925 by Harold St. John (*3502*, WS), who attributed his collection to *A. arthuri* M. E. Jones, which is also present at Lime Hill. St. John's specimen from "mouth of Grande Ronde," which is very likely from the type locality, is actually a mixed collection of *A. arthuri* and *A. asotinensis*. The sheet consists of a complete specimen of *A. arthuri* (sect. *Miselli* (Rydberg) Barneby), including the caudex and multiple stems bearing flowers and fruits, overlain by a meager flowering stem of *A. asotinensis*. The discordant element was recognized in 1953 by R. C. Barneby, who verified the *A. arthuri* determination and annotated the single stem of *A. asotinensis* as "*A. sclerocarpus*?" Because of the lack of fruiting material and overall paucity of the collection, it is understandable that Barneby did not recognize the novelty of *A. asotinensis*. However, he was correct in associating it with section *Podosclerocarpi*.

Astragalus asotinensis differs from all others in section *Podosclerocarpi* in overall vestiture, the relative length of the peduncle to raceme, and the degree of curvature of the mature fruit, as well as the number, shape, and adaxial pubescence of the leaflets (Table 1). Other characteristics that aid in distinguishing species of this section are summarized in Table 1. Among section *Podosclerocarpi*, *A. asotinensis* is most similar to *A. sinuatus*, especially with regard to vegetative and fruit characters that best discriminate *Astragalus* species. With *A. sinuatus*, *A. asotinensis* shares a relatively leafy growth form and moderately curved legumes. However, *A. asotinensis* is readily distinguished by its sparse, strigose pubescence and numerous, narrower leaflets versus the denser, canescent pubescence and fewer, broader leaflets of *A. sinuatus*. Although the dorsal suture of the legume is often sinuous in both species, it is less frequently so in *A. asotinensis*.

Paratypes. U.S.A. **Idaho:** Nez Perce Co., lower slopes of Craig Mt. at mouth of Hells Canyon above Limekiln Rapids, *C. Björk 7684* (ID). **Washington:** Asotin Co., mouth of Grand Ronde River, *St. John 3502*, p.p. (WS); Snake River Canyon, Lime Hill, just E of confluence with Grande Ronde

Table 1. Distinguishing features of *Astragalus asotinensis*, *A. sclerocarpus*, *A. sinuatus*, and *A. speirocarpus*. The range (mean in parentheses) is reported for each quantitative character. See *Paratypes* and *Additional specimens examined* for the list of specimens on which these characters were observed.

Character	*A. asotinensis*	*A. sclerocarpus*	*A. sinuatus*	*A. speirocarpus*
Vestiture of stems and leaves	trichomes short (ca. half the length of other sect. *Podosclerocarpi*), strigose, appressed, sparse; herbage appearing green; leaf upper surface nearly glabrous	trichomes dense, appressed; herbage gray-canescent	trichomes dense, many spreading; herbage gray-canescent	trichomes dense, appressed to ascending; herbage gray-canescent
Stem length (cm)	7–52 (44)	33–50 (42)	30–33 (31)	16–28 (24)
Leaf rachis length (mm)	54–77 (60)	60–82 (72)	25–40 (33)	37–57 (49)
Leaflet length:width ratio	3.5–7.5 (5.1)	7.1–8.9 (8)	2.6–2.9 (2.8)	2.7–4.1 (3.1)
Leaflet number	15–23 (19)	9–13 (11)	11–15 (13)	13–17 (15)
Stipule length (mm)	1.7–3.3 (2.9)	2.7–3.4 (3)	2–3 (2.8)	1.3–1.6 (1.4)
Peduncle:raceme length ratio	3.2–5.2 (4.2)	1.6–2.3 (2.1)	1.7–1.9 (1.8)	1.0–1.7 (1.3)
Legume vestiture	moderately sparse	dense	sparse, mostly along sutures	dense
Legume stipe length (mm)	6–11 (8)	7–23 (15)	6–8 (7)	5–7.5 (6.5)
Legume width (mm)	3–3.5 (3.3)	5.5–8.5 (6.5)	3–6 (4.5)	2.5–4 (3)
Legume curvature (degrees)	40–148 (89)	5–43 (18)	43–68 (51)	480–542 (504)
Legume abaxial suture	straight or sinuate	straight or occasionally sinuate	usually sinuate	straight

Riv., ca. 1 mi. (air) SE of Rogersburg, NW-facing steep slope, *M. Fishbein 3855* (ARIZ, DAV, NY, WS); Lime Hill, W-facing limestone slope, *M. Fishbein 3898* (ARIZ, GH, HPSU, ID, MO, NY, OSC, UC, UTC, WS, WTU); top of Lime Hill, 1.5 mi. (air) SE of Rogersburg, ridge top, *M. Fishbein 3901* (NY, WS); Lime Hill, W-facing limestone slope, *M. Fishbein 3902* (NY, WS); N side of Lime Hill, 1.4 mi. (air) ESE of mouth of Grande Ronde Riv., *C. Björk 4120* (ID, WS, WTU); SE slopes of Lime Hill, 1.6 mi. (air) ESE of mouth of Grande Ronde Riv., *C. Björk 4136* (WS); N slopes of Lime Hill, 1.5 mi. (air) SE of mouth of Grande Ronde Riv., *C. Björk 4405* (OSC, UBC, WS).

Additional specimens examined.

***A. sclerocarpus*: U.S.A. Oregon:** Gilliam/Sherman Co., mouth of John Day Riv., *C. Hitchcock 20434* (WS). **Washington:** Adams Co., 8 mi. N of Kahlotus, *L. Constance 1156* (WS); Benton Co., White Bluffs, Hanford Nuclear Res., 1 May 1984, *R. Angelin s.n.* (WS); 3 mi. S of Hanford, *C. Hitchcock 8184* (WS), *J. Langham 183* (WS); Franklin Co., Pasco, *C. Parker 319* (WS); Grant Co., 0.5 mi. S of W end of O'Sullivan Dam, *S. Harris 62* (WS); 1 mi. W of O'Sullivan Dam, *C. Hitchcock 21867* (WS); 17.25 mi. ESE of Mattawa?, *R. & D. Naas 3999* (WS); jct. of Crab & Wilson Creeks, *Sandberg & Leiberg 312* (WS); Kittitas Co., Ellensburg, May 1896, *H. Hindshaw s.n.* (WS); Klickitat Co.?, Carly to Roosevelt, *F. Pickett 1422* (WS); Walla Walla Co., 2 mi. SW of Attalia, *R. Beattie 3920a* (WS); Wallula, *J. Cotton 1043* (WS).

***A. sinuatus*: Washington:** Washington Terr., *T. S. Brandegee 729* (GH, isotype); Chelan Co., Colockum Creek, 5 mi. from Columbia Riv., *G. Ward 261* (WS); Colockum Creek, 2 mi. from Columbia Riv., *R. & M. Spellenberg 1944* (WS).

***A. speirocarpus*: Washington:** Grant/Kittitas/Yakima Co., Priest Rapids, *J. Mastrogiuseppe 1337* (WS); Kittitas Co., 6 mi. W of Vantage, *R. Daubenmire 5411* (WS), 16 May 1965, *E. Lindgren s.n.* (WS); 7 mi. S of Ellensburg, *C. Hitchcock 22346* (WS); Vantage, *J. Thompson 11439* (WS); Ginkgo State Park, *J. Mastrogiuseppe 1311* (WS); Klickitat Co., Columbia River opposite Alkali, 17 May 1882, *T. J. Howell s.n.* (WS); Yakima Co., Satus Creek, 21 mi. S of Toppenish, *A. Grable 6105* (WS); 20 mi. N of Satus Pass, *C. Hitchcock 3331* (WS); 5 mi. N of Selah, *C. Hitchcock 20173* (WS); Yakima, 12 May 1898, *A. Lackenby s.n.* (WS); Pomona, *E. Nelson 1662* (WS); Horse Heaven Hills S of Toppenish, *J. Witt 1935* (WS).

KEY TO THE SPECIES OF *ASTRAGALUS* SECT. *PODOSCLEROCARPI* (modified from Barneby, 1964)

1a. Pubescence of the calyx and leaflets mostly straight and appressed; leaflets linear or narrowly oblong (l:w = 3–9).

2a. Pubescence dense, plants gray-canescent, but becoming greener with age, longest trichomes > 0.5 mm; leaflets 9 to 13, linear (l:w = 7.1–8.9); body of the legume obliquely or falcately ellipsoid, 6–9 mm high, nearly straight to incurved through 45°; open, sandy habitats; Columbia Basin, from southern British Columbia, through central Washington, to extreme northern Oregon. . . *A. sclerocarpus* A. Gray

2b. Pubescence sparse, plants green, longest trichomes < 0.5 mm; leaflets 15 to 23, oblong to narrowly oblong (l:w = 3.5–7.5); body of the legume linear-oblong, 3–3.5 mm high, incurved 70°–110°; grassland; Asotin County in extreme southeastern Washington and adjacent Nez Perce County, Idaho. . . . . *A. asotinensis* Björk & Fishbein

1b. Pubescence of the calyx and leaflets incumbent or curly; leaflets oblong, obovate-cuneate, or cuneate-obcordate (l:w = 2.6–4.1).
  3a. Peduncles mostly 2–5 cm long; pedicels in fruit 1–2.5 mm long; body of the legume tightly coiled (or equivalently contorted) through 1.25–2.5 circles; Kittitas, Yakima, Benton, and Klickitat Counties in central Washington . . . . . *A. speirocarpus* A. Gray
  3b. Peduncles mostly 4.5–12 cm long; pedicels in fruit 2.7–3.5 mm long; body of the legume gently lunate- or hamate-incurved; very local, rare species of Chelan County in central Washington . . . . . *A. sinuatus* Piper

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